

Kwethluk River Counting Tower Salmon Assessment Project, 1996-1997

by

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and
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Regional Information Report¹ No. 3A98-34

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
Arctic-Yukon-Kuskokwim Region
333 Raspberry Road
Anchorage, Alaska 99518

November 1998

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ACKNOWLEDGEMENTS

Ken Harper (U.S. Fish and Wildlife Service) provided assistance with site selection and some equipment. Charles Burkey and Doug Molyneaux assisted with project design and startup logistics. Native Village of Kwethluk (Kwethluk IRA) employees Tim Fisher, Jimmy Michael, Mike Nicolai, and Harry Jackson, and ADF&G employees Donna Elliot, Spencer Rearden, and Joe Whittom collected data and maintained the tower during the 1996 and 1997 field seasons. Charles Burkey, Jr., Dana Bruden, Jim Menard, Larry Buklis, and Doug Molyneaux reviewed a draft of this report.

PROJECT SPONSORSHIP

Funding for this project was provided by the Bureau of Indian Affairs through the Bering Sea Fishermen's Association. The Alaska Department of Fish and Game provided some equipment and staff time to assist with this project.

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ABSTRACT

In 1996, the Association of Village Council Presidents (AVCP) in cooperation with the Alaska Department of Fish and Game (ADF&G) and the U.S. Fish and Wildlife Service (USFWS) initiated and operated a salmon counting tower on the Kwethluk River, a tributary to the lower Kuskokwim River. In 1997, funding was renewed to continue the project. This report presents the results of the counting tower operations in 1996 and 1997.

In 1996, counting began on 22 June and ceased for the season on 27 July. Passing salmon were counted 20 min per hour from 1200 to 0600 hours. Twenty-minute counts were conducted for 24 h per day at least once per week. Missing hourly counts were estimated using the hourly proportions from days with 24-h counts. Daily salmon passage by species was estimated by multiplying the daily sum of the 20-min counts by 3. The final escapement estimates were 7,415 chinook, 1,801 sockeye, and 26,049 chum. Because pink and coho salmon spawning migrations were just beginning when the tower ceased operation, total escapement of these species was not fully assessed.

In 1997, counting began on 22 June and ceased for the season on 12 August. From 22 June to 14 July, passing salmon were counted 20 min per hour between from 1200 to 0600 hours. Twenty minute counts were conducted for 24 h per day at least twice per week. After 14 July, 20-min counts continued for 24 h per day. Missing 20-min counts were estimated using the hourly proportions from the 24-h counts. Daily salmon passage by species was estimated by multiplying the daily sum of the 20-min counts by 3. The final escapement estimates were 10,395 chinook, 1,374 sockeye, and 10,659 chum. Because pink and coho salmon spawning migrations were just beginning when the tower ceased operation total escapement of these species was not fully assessed.

In both years the tower project was deemed successful in estimating escapement for chinook, sockeye, and chum salmon. To adequately assess coho and pink salmon escapements, the tower would have to operate until at least mid-September. Although species identification by the tower crew did not appear to be a significant problem, tower operation in following years should include verification of salmon identification.

INTRODUCTION

Draining an area of about 3,400 km², the Kwethluk River originates in the Kilbuck Mountains and flows for approximately 220 km to the Kuskokuak Slough of the Kuskokwim River (Brown 1983). Most of the Kwethluk River drainage is within the Yukon-Kuskokwim Delta National Wildlife Refuge. The mouth of the Kwethluk River, where the village of Kwethluk (population ~650) is located, is about 170 km from the mouth of the Kuskokwim River. The lower 5 km of the Kwethluk River is tidally influenced.

Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, sockeye *O. nerka*, coho *O. kisutch*, and pink salmon *O. gorbuscha* spawn in the Kwethluk River. Resident species commonly found in the Kwethluk River include rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, northern pike *Esox lucius* and whitefish *Coregonus spp.*

Subsistence and commercial fishers who live along the Kuskokwim River place major cultural and economic importance on harvests of salmon. Commercial fisheries occur in two non-contiguous districts (Districts 1 and 2) in the Kuskokwim River stretching from the river mouth to Chuathbaluk (Figure 1). The 10-year average (1988-1997) commercial harvest for both districts combined is approximately 31,000 chinook, 64,000 sockeye, 451,000 chum, and 545,000 coho salmon (Burkey et al. 1997). The 1988-1997 average subsistence harvest of chinook, sockeye, chum and coho salmon in the Kuskokwim River is approximately 83,000, 35,000, 100,000, and 37,000 respectively (Burkey et al. 1997). The Kwethluk River is one of many salmon producing tributaries of the Kuskokwim River that support these fisheries.

Kwethluk River salmon stocks are harvested by commercial and subsistence fishers in District 1 and by subsistence and sport fishers in the Kwethluk River. The overall exploitation rate of Kwethluk River stocks is unknown due to the lack of stock identification tools. Previous genetic studies have not been able to distinguish among stocks of early or summer-run chum salmon in the Kuskokwim River (Seeb et al. 1998). Genetic stock identification of other species has not been investigated.

In 1992, the U.S Fish and Wildlife Service operated a floating weir on the Kwethluk River. This project was successful in enumerating salmon escapement from 21 June through 12 September. In 1996, the Association of Village Council Presidents (AVCP) in cooperation with the Alaska Department of Fish and Game (ADF&G) initiated and operated a salmon counting tower. In 1997, funding was renewed to continue the project. This report presents the results of the 1996 and 1997 counting tower operation.

METHODS

Study Site

The counting tower and field camp were located approximately 130 rkm from Bethel (60.29.049

N lat.;161.05.296 W long.; Figure 2). The camp and one tower were located on the left bank of the river approximately 3 km upstream from the 1992 weir site. The channel width at the tower site was approximately 53 m. Immediately upstream from the tower site, a narrow and shallow channel branches off the mainstem and joins an old oxbow which rejoins the mainstem several hundred meters downstream from the tower site. No fish were observed attempting to migrate through this small channel.

Tower Operation

1996

A single 20-foot tower made of scaffolding was used as an observation platform. A fish lead consisting of wooden tripods and tubular aluminum panels was used to redirect fish passage towards the tower side of the river channel. Three 500-watt halogen lamps were mounted on the tower to illuminate the counting area during night. The lamps were turned on prior to the first count when needed and left on until there was adequate daylight. White sandbags were used as a "flash panel" to help see and identify passing salmon. Approximately 25 m of channel was open to fish passage. Salmon were counted for 20 min each hour from 1200 to 0600 hours (18 h per day). The 18-h schedule was used to work within labor budget constraints and to allow time for collecting salmon with a beach seine for age, sex and length (ASL) sampling. Approximately once per week, 20-min counts were made for 24 h. Counts began on 21 June and ended on 27 July.

1997

The fish lead structure, flash panels and tower were constructed and situated similar to that in 1996. The counting schedule from 20 June to 14 July was to count 20 min per hour for 18 h per day, 7 days per week. Hours between 0600 and 1200 hours were not sampled except three days per week when counts continued for 24 h. The 18-h schedule was used to work within labor budget constraints and to allow time for collecting salmon with a beach seine for age, sex and length (ASL) sampling. Because ASL sampling was not successful it was discontinued on 14 July; thereafter, 20 min counts were made 24 h per day, 7 days per week.

Data Analysis

1996

To estimate salmon passage during the 20-min period for hours when no counts were made, the

proportion of counts from 0600 to 1200 hours on the days with 24-hour counts were used. The proportions from a particular 24-h count were used to estimate the missing hours on half the number of days prior and half the number of days following the day with the 24-h count. If the number of days between 24-h counts was odd, hourly proportions from the prior 24-h count were used for the extra day. The total or "expanded" count for each day was calculated by multiplying the sum of the actual and estimated counts for the 20-min periods by 3. The number of hours counted were too few to use the 24-h proportions on 26 June, 12-15 July and 27 July. For 26 June, the 20-min counts were estimated as the average of the counts on the day before and day after. No estimates for missing counts were made for the other days due to a lack of sufficient data on adjacent days.

1997

The procedure for estimating missing 20-min counts and expanded daily total counts in 1997 was the same as in 1996. Estimating missing 20-min counts was not necessary after 14 July because counts were made 24 h per day.

RESULTS

1996

Counting first began at 0000 hours on 22 June and ended for the season at 0500 hours on 27 July. Counts were suspended from 0600 hours on 12 July to 0000 hours on 15 July and then again from 0300 to 2000 hours on 15 July due to high water level and poor clarity. Counting ended for the season due to persistent high water conditions (Appendix A.1). Tables 1 through 5 present the actual and estimated hourly 20-min counts of each salmon species.

The total estimated count of chinook salmon was 7,415 (Table 6). Chinook salmon were first counted on 22 June and were counted until the end of the operational period. The midpoint of the chinook run occurred on 7 July. The run appeared to suddenly peak on 4 July then taper off slowly (Figure 3).

The total estimated count of sockeye salmon was 1,801 (Table 6). Sockeye were first counted on 26 June and were counted until the end of the operational period. The midpoint and peak of the sockeye run occurred on 7 July (Figure 3).

The total estimated count of chum salmon was 26,049 (Table 6). Chum were first counted on 22 June and passage continued to be 200-300 per day by the end of the operational period. The midpoint of the chum run occurred on 8 July and the run peaked on 4 July (Figure 3).

The total estimated count of pink salmon was 2,853 (Table 6). Pinks were first counted on 3 July and were counted until the end of the operational period. Because the pink run was expected to peak about mid-August and continue to mid-September, no conclusions on run timing or strength were made for 1996.

The total estimated count of coho salmon was 189 (Table 6). Coho were first counted on 21 July and were counted until the end of the operational period. Because the coho run was expected to peak around late August and continue well into September, no conclusions on run timing or strength were made for 1996.

1997

Counting first began at 0000 hours on 22 June and operations ended for the season at 0700 hours on 12 August. During the operational period few counts were impaired by weather, water level, and clarity. Although operations ceased due to poor water conditions the overall conditions for counting fish from a tower were exceptional (Appendix A.2). Tables 7 through 11 present the actual and estimated hourly 20-min counts of each salmon species.

The total estimated count of chinook salmon was 10,395 (Table 12). Chinook salmon were first counted on 23 June and were counted until the end of the operational period. The midpoint of the chinook run occurred on 6 July. The run appeared to be bimodal; a major peak occurred on 5 July and a minor peak on 19 July (Figure 4).

The total estimated count of sockeye salmon was 1,374 (Table 12). Sockeye were first counted on 5 June and were last counted on 26 July. The midpoint of the sockeye run occurred on 4 July and the run peaked on 4 July (Figure 4).

The total estimated count of chum salmon was 10,659 (Table 12). Chum were first counted on 23 June and were counted until the end of the operational period. The midpoint of the chum run occurred on 19 July. The chum run appeared to be bimodal; a minor peak occurred on 4 July and a major peak on 19 July (Figure 4).

The total estimated count of pink salmon was 1,008 (Table 12). Pinks were first counted on 9 July and were counted until the end of the operational period. Because the pink run was expected to peak about mid-August and continue to mid-September, no conclusions were made on run timing for 1997.

The total estimated count of coho salmon was 1,110 (Table 12). Coho were first counted on 30 July and were counted until the end of the operational period. Because the coho run was expected to peak during late August and continue well into September, no conclusions were made on run timing for 1997.

DISCUSSION

An important aspect of the escapement estimates from this tower project, and most tower projects in general, is ensuring that estimated portions of the total are not biased. The estimated portions consist of expanding the 20-min counts in addition to estimating 20-min counts for hours not counted then expanding those estimates. Possible factors that could affect the extrapolated counts include driving a boat across the river or other activity such as making repairs to the flash panels. In 1996 and 1997, no known activities took place that would have seriously affected the counts. The tower and camp were located on the same riverbank so there was no need to frequently cross the river. Flash panel repairs were generally done during the morning hours (0600 to 1200 hours). Estimating the hours of missing counts depends on fish passage being consistent from day to day. For the most part, this seems to have been true judging from the 24-h counts in 1997. However, there are some days with somewhat anomalous hourly proportions during the morning hours. While this does suggest some of the estimates may be biased, fish passage was generally low during the morning hours thus lessening the degree of uncertainty in daily passage estimates and the overall escapement estimate.

The estimated chinook salmon escapement in 1997 (10,395) was higher than in previous years of assessment. The total count of chinook from the Kwethluk floating weir project in 1992 was 9,675 (Harper 1998) and the tower estimate in 1996 was approximately 7,900; with only about 3% to 5% of the run yet to pass based on run timing in 1992. Other escapement projects such as the Kogrukluk River weir in the Holitna River drainage, and the George River weir, indicated average or above average chinook salmon escapement in 1997 (Burkey et al. 1997.). Chinook (and sockeye) salmon are harvested by subsistence fishers and incidentally in the commercial chum fishery in the Kuskokwim River. Because of a poor chum run in 1997, only one commercial period was allowed in District 1 during the 1997 chum run, thus reducing the incidental chinook harvest.

The estimated sockeye salmon escapement in 1997 (1,374) was comparable to 1992 when 1,316 were counted, but less than the 1,804 estimated in 1996. In comparison the 1997 sockeye run at the Kogrukluk River weir was less than in 1996, but considerably more than in 1992. Typical sockeye rearing habitat, such as large volume lakes, is absent in the Kwethluk River drainage. There are some smaller lakes in the headwaters but their potential for sockeye productivity is unknown. Similar to the Holitna River, the sockeye salmon in the Kwethluk are most likely a "river-type"; that is they spawn and rear exclusively in flowing waters.

The estimated chum salmon escapement in 1997 (10,659) was considerably lower than the previous years of assessment; about one-third of the escapement estimates in 1992 (30,596) and 1996 (26,049). Low chum escapement was observed at other assessment projects throughout the Kuskokwim River drainage, and as mentioned above, only one commercial fishing period was allowed in District 1 during the chum run.

The Kwethluk River tower operation ended before escapements of pink and coho salmon could be assessed. In 1992, the floating weir operated until 12 September well after peak migration of

both species. The coho and pink salmon escapements in 1992 were 45,952 and 45,605 respectively. Pink salmon exhibit even year dominance and were not expected to arrive in high numbers in 1997. Pink salmon generally occur in relatively low numbers in the Kuskokwim River and are not a very utilized commercial or subsistence resource. As a consequence, little is actually known about the run dynamics and escapement of pink salmon throughout the Kuskokwim River. The count of pinks at the Kwethluk River weir in 1992 was the highest documented escapement of this species in any stream in the Kuskokwim Area.

Because the Kwethluk River tower is relatively far upstream and close to the spawning grounds, most salmon observed passing are water marked (in spawning coloration) and fairly easy to identify. Species identification problems are inherent in any fish counting tower project where more than one species occurs. The Kwethluk tower is no exception, and although species identification problems were not assessed, misidentification was presumed low. The Kwethluk River characteristically is susceptible to high water from seasonal freshets, and murky water caused by clay or loess riverbanks. The tower is on the west side of the river and glare from the morning sun has a negative impact on an observer's ability to see fish. Fortunately, fish passage is generally low during these hours. During 1997, there were few periods of weather or water conditions that would have severely impaired counting fish. Water conditions were low throughout the Kuskokwim River drainage, and in some areas, local elders had not seen such low water in over 20 years.

RECCOMENDATIONS

Overall, the Kwethluk River tower project was operated extremely well in 1997. The field technicians were very experienced with making natural observations and recognizing salmon species. However, the remoteness of the tower and field camp has both negative and positive aspects. There are few suitable sites for a tower downstream so the general vicinity of the present location is appropriate. The biggest difficulties with tower operations was collecting ASL information and maintaining the morale of the crew.

Subsistence activities are a necessary part of life in the Kuskokwim area, and not always compatible with a wage-earning work schedule. One way to alleviate this problem is to rotate personnel on a one-week-on and one-week-off schedule or something to that nature. This may demand hiring an additional person, but having additional people trained and familiar with such a project is also a benefit. There are many variations of scheduling employees for tower projects but the main point is to get as many 24-h counts as possible and maintain crew morale. It is recommended however that prior to hiring or rehiring personnel, their needs are identified and all attempts should be made to accommodate them with a flexible schedule.

Sampling for ASL information was unsuccessful in 1996 and 1997. Therefore, such attempts should not be made in the future. Instead, this project should concentrate on counting for 24 h per day, or no less than 18 h per day, 7 days per week. The tower operation should continue as long as the budget will allow, but there is little reason to continue past mid-August if the objectives do

not include enumerating coho and pink salmon. Each person should count 8 hours, therefore a maximum of three people are needed at all times. An 18-h per day count schedule is only acceptable if 24-h counts can be made regularly; on the order of 2 or 3 times a week would be desirable. There are many ways of scheduling employees for tower projects, but the main objective should be to maximize the number of counts while maintaining crew morale, and staying within budget.

Although species identification was not known to be a significant problem at the Kwethluk River tower, differences in identification among the crew should be assessed, especially if new crew members are hired. Accurately validating the species of passing salmon would be extremely difficult, but knowing the relative observer error would be important for assessing the overall success of the project. One difficulty that was apparent during 1997 was the inadequacy of the lighting system for counting at night. The lights used were too diffuse, and more concentrated spot-type lighting is needed. Also needed is a better flash-panel system. The current method of using white sand bags is acceptable only as a last resort. There are several products that would work, such as white plastic panels or a type of fine-mesh heavy metal fencing.

The difficult accessibility of the Kwethluk River tower site complicates logistics. In 1997 numerous costly trips by jetboat were made to resupply the camp with food, gas and supplies. With some careful planning, supply trips should not be necessary more than once per week. At the beginning of the season enough trips should be made to haul in gas and food staples to last for several weeks. A regular supply trip schedule should be established so that the crew knows when to expect supplies, and people who are involved with the project can plan ahead for visiting and helping out. Communications with a VHF radio to Bethel were often unreliable. Use of single-side-band radio with the ADF&G office seemed to be the best way to communicate and should be used in following years.

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Table 1. Net upstream passage of chinook salmon during hourly 20-min counts at the Kwethluk River tower, 1996. Numbers within boxes are estimates based on days when 24 h were counted.

Hours																									Total	Expanded		
Date	Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Count	Count	
06/22	24	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	5	15	
06/23	18	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	2	10	1	0	4	4	7	0	1	34	102	
06/24	19	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	7	0	3	2	0	18	53	
06/25	18	0	0	0	0	1	0	1	1	0	0	0	0	1	1	0	3	1	2	1	2	1	0	1	0	16	48	
06/26	8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	2	1	1	1	1	2	0	4	0	17	51	
06/27	24	2	2	1	1	1	3	1	1	0	0	0	0	0	1	1	1	0	0	0	0	2	0	6	2	25	75	
06/28	18	4	1	0	0	0	0	3	3	0	0	0	0	2	5	3	3	1	3	2	8	26	1	5	2	72	216	
06/29	18	2	0	1	0	3	0	3	3	0	0	0	0	0	0	0	2	0	2	2	5	29	15	10	7	84	252	
06/30	18	5	4	0	4	2	4	3	3	0	0	0	0	3	4	10	0	2	1	2	2	7	5	6	4	71	213	
07/01	18	1	3	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	2	2	1	0	3	1	17	51	
07/02	18	2	3	1	2	2	0	0	0	0	2	0	3	0	0	1	-1	1	0	3	2	8	5	3	1	38	114	
07/03	24	6	1	1	5	0	0	0	0	0	2	0	3	0	2	5	1	0	3	2	2	8	1	0	0	42	126	
07/04	18	0	1	0	0	5	0	0	0	0	18	0	26	2	0	0	2	12	32	10	6	90	46	71	47	368	1,104	
07/05	18	26	18	22	13	2	5	0	0	0	12	0	18	10	8	2	1	4	27	6	35	11	10	16	4	250	750	
07/06	18	20	36	21	2	0	0	0	0	0	9	0	13	1	1	24	3	14	4	8	4	9	16	3	0	188	564	
07/07	18	6	3	0	1	0	1	0	0	0	5	0	8	0	0	6	0	0	4	12	1	12	33	15	5	112	336	
07/08	16	23	11	3	1	0	0	0	0	0	6	0	9	9	3	2	1	0	12	3	8	9	13	6	9	128	384	
07/09	18	21	16	6	16	4	3	0	0	0	8	0	12	0	1	2	17	3	4	0	0	10	7	33	10	173	519	
07/10	18	18	15	10	1	0	1	3	6	0	2	1	5	3	0	2	3	5	7	1	0	10	4	16	4	117	351	
07/11	18	6	12	7	0	2	1	2	4	0	1	1	3	1	2	0	3	2	1	1	5	2	3	9	5	73	219	
07/12	9	4	4	4	0	1	5																			18	54	
07/13	0																									0	0	
07/14	0																									0	0	
07/15	7	5	3	6																		2	4	3	0	23	69	
07/16	24	4	0	5	2	1	6	3	7	0	2	1	6	2	5	10	20	6	6	18	12	6	3	0	4	129	387	
07/17	18	7	2	3	6	0	0	2	5	0	1	1	4	1	1	5	4	9	2	1	0	11	4	9	8	86	258	
07/18	18	0	1	7	1	2	0	1	3	0	1	0	2	-1	1	1	6	5	2	3	6	5	2	3	1	52	156	
07/19	18	3	3	0	3	5	4	2	4	0	1	1	4	2	-1	2	4	3	9	8	1	1	9	5	9	82	246	
07/20	18	1	0	4	1	4	0	1	3	0	1	0	2	1	1	0	0	1	2	3	5	1	2	7	9	49	147	
07/21	18	4	2	1	1	0	2	2	4	0	1	1	3	0	-1	1	2	10	9	2	7	0	7	7	9	74	222	
07/22	18	1	0	4	0	2	0	0	0	54	0	0	-54	-1	0	8	5	2	15	5	5	3	2	2	1	54	162	
07/23	18	1	3	0	0	1	0	0	0	24	0	0	-24	0	2	3	5	4	2	0	1	1	1	0	0	24	72	
07/24	18	-1	2	3	0	2	2	0	0	16	0	0	-16	0	0	0	0	1	0	2	3	0	0	1	1	16	48	
07/25	18	0	0	0	0	0	0	0	0	13	0	0	-13	2	3	-2	5	4	0	0	0	0	0	1	0	13	39	
07/26	24	0	1	0	1	0	1	0	0	1	0	0	-1	-2	0	1	0	-1	-2	-1	0	1	1	0	1	1	3	9
07/27	6	0	0	0	1	0	2																			3	9	

Table 2. Net upstream passage of chum salmon during hourly 20-min counts at the Kwethluk River tower, 1996. Numbers within boxes are estimates based on days when 24 h were counted.

Date	Hours Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total Count	Expanded Count
6/22	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3
6/23	18	1	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	27	0	1	6	4	1	0	0	44	132
6/24	19	0	-1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	13	17	9	48	144
6/25	18	0	0	0	1	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/26	8	1	1	2	0	1	3	4	2	0	0	0	0	0	2	4	1	5	1	3	3	5	0	11	1	50	150
6/27	24	20	21	14	13	7	10	7	3	0	0	0	0	5	4	8	1	10	1	6	5	10	0	21	6	172	516
6/28	18	5	21	4	13	2	7	4	2	0	0	0	0	0	0	0	1	3	5	5	1	16	3	3	7	102	306
6/29	18	5	7	11	15	5	1	11	5	0	0	0	0	5	1	0	7	26	7	11	18	19	47	34	36	271	813
6/30	18	22	26	21	73	21	12	17	7	0	0	0	0	39	15	10	5	6	5	38	26	26	23	10	15	417	1,251
7/1	18	5	2	9	5	4	0	0	1	1	1	0	1	0	5	2	3	0	8	5	9	3	11	13	35	123	369
7/2	18	19	18	14	12	7	0	0	1	1	2	0	2	2	3	9	4	9	7	10	7	31	23	11	36	228	684
7/3	24	29	13	30	24	14	40	0	2	2	3	0	3	6	22	26	28	12	15	6	26	13	39	7	33	393	1,179
7/4	18	17	28	59	60	31	58	0	5	5	7	0	7	2	40	8	30	66	72	31	27	164	62	42	120	941	2,823
7/5	18	73	35	38	28	5	8	0	2	2	3	0	3	5	13	5	4	17	79	14	33	18	19	31	14	449	1,347
7/6	18	58	100	76	46	16	7	0	3	3	4	0	4	4	5	23	7	35	19	14	14	57	33	23	21	572	1,716
7/7	18	18	41	23	38	3	2	0	3	3	5	0	5	1	2	5	6	0	14	33	11	167	180	53	29	642	1,926
7/8	16	45	17	40	35	19	54	0	3	3	4	0	4	1	3	0	8	9	16	4	25	29	37	84	91	531	1,593
7/9	18	30	37	25	23	16	10	0	2	2	3	0	3	0	0	2	16	1	7	0	9	48	50	43	6	333	999
7/10	18	21	24	15	21	11	16	13	6	3	3	8	8	3	2	3	2	3	11	8	9	14	14	59	24	301	903
7/11	18	22	31	19	2	9	14	9	4	2	2	5	5	8	3	0	6	3	3	4	8	5	14	19	13	210	630
7/12	9	19	15	17	18	22	36	3	3	-7	0															126	378
7/13	0																									0	0
7/14	0																									0	0
7/15	7	18	21	29																		43	20	22	47	200	600
7/16	24	61	38	22	47	55	27	21	10	5	5	13	13	10	2	5	12	26	22	21	16	23	19	8	20	501	1,503
7/17	18	17	22	15	16	3	3	7	3	2	2	4	4	0	2	5	7	8	5	5	0	7	5	16	14	172	516
7/18	18	5	18	10	11	13	0	5	2	1	1	3	3	2	1	6	6	2	3	2	7	1	4	6	7	119	357
7/19	18	15	19	4	11	11	4	8	4	2	2	5	5	2	6	4	2	2	1	11	3	10	13	36		191	573
7/20	15	16	7	8	12	13	5	12	6	3	3	8	8	6	5	6	12	15	6	15	5	27	11	65	21	295	885
7/21	18	12	20	28	38	22	10	18	9	4	4	11	11	6	9	17	10	15	18	25	29	26	53	19	18	432	1,296
7/22	18	12	7	9	17	6	6	11	7	5	0	9	7	5	7	16	3	11	11	11	5	14	4	14	12	209	627
7/23	18	18	12	8	5	10	4	9	5	4	0	7	5	2	2	4	9	10	10	4	4	0	13	6	9	160	480
7/24	18	21	16	15	15	7	5	11	7	4	0	9	7	2	2	3	4	5	11	7	9	8	21	4	6	199	597
7/25	18	12	7	16	5	13	4	6	3	2	0	4	3	1	1	1	5	1	2	0	1	5	2	3	4	101	303
7/26	24	5	10	7	7	9	7	5	3	2	0	4	3	0	0	1	3	2	3	8	2	1	3	1	5	91	273
7/27	6	2	11	11	17	8	10																			59	177

Table 3. Net upstream passage of sockeye salmon during hourly 20-min counts at the Kwethluk River tower, 1996. Numbers within boxes are estimates based on days when 24 h were counted.

Date	Hours																								Total	Expanded	
	Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Count	Count
06/22	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/24	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/25	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/26	8	0	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	1	2	1	0	0	1	11	33
06/27	24	0	0	2	0	0	2	0	0	0	0	0	0	4	2	4	0	1	0	2	4	1	0	0	1	23	69
06/28	18	3	13	0	2	2	0	0	0	0	0	0	0	1	0	0	0	5	4	0	1	2	0	2	0	35	105
06/29	18	1	0	0	1	1	1	0	0	0	0	0	0	0	0	1	2	1	0	2	4	0	0	7	21	63	
06/30	18	0	0	1	2	0	0	0	0	0	0	0	0	0	9	2	0	2	0	5	2	0	2	0	0	25	75
07/01	18	0	1	5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	5	1	18	54
07/02	18	2	0	0	6	0	0	0	0	0	0	0	1	0	0	0	0	3	0	8	2	8	4	0	4	38	114
07/03	24	2	3	6	6	2	4	0	0	0	0	0	1	0	2	4	1	1	1	1	1	5	0	0	5	45	135
07/04	18	2	5	1	7	3	4	0	0	0	0	0	1	1	1	0	1	1	2	0	0	1	0	0	0	30	90
07/05	18	0	4	5	8	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	23	69
07/06	18	5	8	7	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	1	3	1	0	29	87
07/07	18	0	2	1	4	0	0	0	0	0	0	0	1	0	1	2	0	0	2	9	2	7	15	7	3	56	168
07/08	16	13	1	4	2	1	3	0	0	0	0	0	1	0	0	0	1	0	2	0	1	0	0	3	0	32	97
07/09	18	12	6	6	5	2	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	1	0	0	37	111
07/10	18	1	1	3	0	0	1	0	0	0	0	0	0	1	0	2	1	0	1	0	0	0	0	0	0	11	33
07/11	18	6	3	8	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	4	30	90
07/12	9	4	3	2	7	0	2	0	0	0	-1															17	51
07/13	0																									0	0
07/14	0																									0	0
07/15	7	3	2	4																		2	2	0	0	13	39
07/16	24	0	1	3	1	1	0	0	0	0	0	0	0	0	0	3	2	1	1	0	0	0	0	0	1	14	42
07/17	18	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6	1	4	4	22	66
07/18	18	1	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	8	24
07/19	18	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	2	0	0	10	30
07/20	18	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0	2	1	4	4	19	57
07/21	18	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	2	1	5	0	2	14	42
07/22	18	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	9
07/23	18	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
07/24	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07/25	18	0	3	3	4	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	13	39
07/26	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07/27	6	1	0	0	0	0	0																			1	3

Table 4. Net upstream passage of pink salmon during hourly 20-min counts at the Kwethluk River tower, 1996. Numbers within boxes are estimates based on days when 24 h were counted.

Date	Hours Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total Count	Expanded Count
6/22	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/24	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/26	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/27	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/29	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/30	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	3
7/4	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	2	0	0	0	0	0	6	14	42
7/5	18	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	10	30
7/6	18	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	14	42
7/7	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	9	4	3	2	24	72	
7/8	16	17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	27	81	
7/9	18	10	3	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	1	1	0	21	63	
7/10	18	0	0	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	1	11	33	
7/11	18	0	4	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	6	18	
7/12	9	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21	
7/13	0																								0	0	
7/14	0																								0	0	
7/15	7	6	10	13				1	0	1	1	0	1	2	2	2	2	4	0	0	7	4	3	7	50	150	
7/16	24	2	13	7	9	3	0	1	0	1	1	0	1	0	0	2	2	0	0	1	0	5	2	5	6	68	204
7/17	18	4	0	7	3	1	1	1	0	0	0	0	0	0	0	2	0	0	7	1	-1	0	1	2	2	43	129
7/18	18	0	1	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	7	1	-1	0	1	2	2	23	69
7/19	18	3	24	4	1	0	1	1	0	1	1	0	1	1	1	1	0	-1	0	2	5	0	1	4	8	59	177
7/20	18	5	3	4	2	1	2	1	0	1	1	0	1	0	0	0	1	3	0	3	7	6	0	7	9	57	171
7/21	18	0	13	13	6	8	0	2	0	2	2	0	2	3	1	1	3	1	8	21	6	6	17	5	7	127	381
7/22	18	8	4	14	16	3	2	7	5	4	4	4	-5	1	0	1	2	1	7	10	0	3	2	6	5	104	312
7/23	18	4	10	3	3	8	1	5	3	2	2	2	-3	4	-1	1	2	0	3	1	1	0	11	2	2	66	198
7/24	18	5	6	5	4	5	3	4	3	2	2	2	-3	1	2	1	-2	0	5	3	1	3	5	1	5	63	189
7/25	18	8	7	16	5	3	4	6	4	3	3	3	-4	0	4	2	5	0	3	2	0	0	2	4	4	84	252
7/26	24	3	8	0	4	9	6	4	3	2	2	2	-3	1	0	0	2	4	3	0	3	2	1	2	0	58	174
7/27	6	7	1	2	4	-1	1																			14	42

Table 5. Net upstream passage of coho salmon during hourly 20-min counts at the Kwethluk River tower, 1996. Numbers within boxes are estimates based on days when 24 h were counted.

Date	Hours Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total Count	Expanded Count
6/22	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/24	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/26	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/27	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/29	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/30	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/5	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/11	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13	0																									0	0
7/14	0																									0	0
7/15	7	0	0	0																		0	0	0	0	0	0
7/16	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/19	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/20	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/21	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	2	0	0	5	15
7/22	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	3	9
7/23	18	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
7/24	18	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	3	0	2	2	3	1	1	15	45
7/25	18	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	8	24
7/26	24	1	1	4	3	2	2	0	0	0	1	1	1	0	1	0	0	0	2	1	0	2	0	1	0	23	69
7/27	6	0	0	2	4	1	0																			7	21

Table 6. Daily salmon passage estimates at the Kwethluk River tower 1996. Counts less than 24 h are extrapolated to full day counts.

Date	Hours Count	Chinook			Sockeye			Chum			Pink		Coho	
		Daily Total	Cum. Total	Cum. %	Daily Total	Cum. Total	Cum. %	Daily Total	Cum. Total	Cum. %	Daily Total	Cum. Total	Daily Total	Cum. Total
06/22	24	15	15	0	0	0	0	3	3	0	0	0	0	0
06/23	18	102	117	2	0	0	0	132	135	1	0	0	0	0
06/24	18	53	170	2	0	0	0	144	279	1	0	0	0	0
06/25	18	48	218	3	0	0	0	0	279	1	0	0	0	0
06/26	7	51	269	4	33	33	2	150	429	2	0	0	0	0
06/27	24	75	344	5	69	102	6	516	945	4	0	0	0	0
06/28	18	216	560	8	105	207	11	306	1,251	5	0	0	0	0
06/29	18	252	812	11	63	270	15	813	2,064	8	0	0	0	0
06/30	18	213	1,025	14	75	345	19	1,251	3,315	13	0	0	0	0
07/01	18	51	1,076	15	54	399	22	369	3,684	14	0	0	0	0
07/02	18	114	1,190	16	114	513	28	684	4,368	17	0	0	0	0
07/03	24	126	1,316	18	135	648	36	1,179	5,547	21	3	3	0	0
07/04	18	1,104	2,420	33	90	738	41	2,823	8,370	32	42	45	0	0
07/05	18	750	3,170	43	69	807	45	1,347	9,717	37	30	75	0	0
07/06	18	564	3,734	50	87	894	50	1,716	11,433	44	42	117	0	0
07/07	18	336	4,070	55	168	1,062	59	1,926	13,359	51	72	189	0	0
07/08	16	384	4,454	60	97	1,159	64	1,593	14,952	57	81	270	0	0
07/09	18	519	4,973	67	111	1,270	71	999	15,951	61	63	333	0	0
07/10	18	351	5,324	72	33	1,303	72	903	16,854	65	33	366	0	0
07/11	18	219	5,543	75	90	1,393	77	630	17,484	67	18	384	0	0
07/12	9	54	5,597	75	51	1,444	80	378	17,862	69	21	405	0	0
07/13	0	0	5,597	75	0	1,444	80	0	17,862	69	0	405	0	0
07/14	0	0	5,597	75	0	1,444	80	0	17,862	69	0	405	0	0
07/15	7	69	5,666	76	39	1,483	82	600	18,462	71	150	555	0	0
07/16	24	387	6,053	82	42	1,525	85	1,503	19,965	77	204	759	0	0
07/17	18	258	6,311	85	66	1,591	88	516	20,481	79	129	888	0	0
07/18	18	156	6,467	87	24	1,615	90	357	20,838	80	69	957	0	0
07/19	18	246	6,713	91	30	1,645	91	573	21,411	82	177	1,134	0	0
07/20	15	147	6,860	93	57	1,702	95	885	22,296	86	171	1,305	0	0
07/21	18	222	7,082	96	42	1,744	97	1,296	23,592	91	381	1,686	15	15
07/22	18	162	7,244	98	9	1,753	97	627	24,219	93	312	1,998	9	24
07/23	18	72	7,316	99	6	1,759	98	480	24,699	95	198	2,196	6	30
07/24	18	48	7,364	99	0	1,759	98	597	25,296	97	189	2,385	45	75
07/25	18	39	7,403	100	39	1,798	100	303	25,599	98	252	2,637	24	99
07/26	24	3	7,406	100	0	1,798	100	273	25,872	99	174	2,811	69	168
07/27	6	9	7,415	100	3	1,801	100	177	26,049	100	42	2,853	21	189

Table 7. Net upstream passage of chinook salmon during hourly 20-min counts at the Kwethluk River tower, 1997. Numbers within boxes are estimates based on days when 24 h were counted.

Hours																									Total	Expanded	
Date	Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Count	Count
6/22	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	3	10	3	0	0	0	0	1	0	0	0	17	51
6/24	24	10	5	1	1	5	3	0	0	0	0	0	0	0	0	0	9	4	6	29	0	1	14	0	8	96	288
6/25	17	0	0	0	0	1	0	0	0	0	0	0	0	0	0	7	0	0	4	7	5	9	2	3	8	46	138
6/26	18	2	4	4	5	2	1	0	0	0	0	0	0	0	0	0	2	2	4	0	6	5	8	3	3	51	153
6/27	18	2	9	10	5	5	4	0	0	0	0	0	0	2	0	2	0	3	15	0	0	0	6	6	3	72	216
6/28	24	8	28	10	9	6	7	0	0	0	0	0	0	0	16	13	0	1	2	1	0	0	0	6	1	108	324
6/29	18	4	38	22	8	5	0	0	0	0	0	0	0	1	1	11	2	1	0	8	1	0	2	1	0	105	315
6/30	18	17	25	27	5	3	2	0	0	0	0	0	0	0	1	0	0	0	0	0	3	4	0	0	0	87	261
7/1	18	0	2	9	3	2	0	0	0	0	0	0	0	0	0	1	3	0	0	0	1	0	0	0	0	21	63
7/2	24	0	5	13	15	7	0	1	3	1	0	0	0	1	0	3	0	16	28	0	2	8	9	4	32	148	444
7/3	18	8	9	15	4	2	6	2	5	2	0	0	0	2	21	2	0	0	0	63	38	45	24	3	8	259	777
7/4	18	27	11	14	17	8	7	2	6	2	0	0	0	0	1	1	11	2	7	115	8	16	5	3	12	275	825
7/5	18	55	27	44	52	34	53	16	9	0	0	0	6	0	0	3	14	5	5	2	33	29	0	7	6	400	1,200
7/6	24	102	30	37	15	17	15	14	8	0	0	0	5	0	2	19	7	4	1	47	6	17	3	1	0	350	1,050
7/7	18	1	26	4	2	1	1	2	1	0	0	0	1	0	0	0	0	0	1	2	0	2	0	4	1	49	147
7/8	18	6	6	3	6	1	4	1	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	31	93
7/9	18	0	0	1	2	1	-2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	5	15
7/10	24	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	-2	0	0	0	0	1	0	0	0	1	3
7/11	18	1	10	0	0	0	2	0	0	0	0	0	0	0	0	1	1	5	2	0	0	0	0	0	1	23	69
7/12	18	1	6	3	4	1	8	0	0	0	0	0	0	0	0	2	3	-1	4	-1	0	0	0	1	0	31	93
7/13	18	13	2	9	3	0	0	1	3	0	2	2	0	0	0	0	12	0	-1	1	2	0	10	1	2	62	186
7/14	24	3	10	10	11	2	0	1	3	0	2	2	0	5	2	6	0	0	0	0	0	1	0	0	6	64	192
7/15	24	0	3	4	0	2	0	0	0	1	0	0	0	-1	0	-1	2	0	4	-1	0	1	13	29	2	58	174
7/16	24	9	15	7	13	7	6	17	6	1	1	0	2	2	1	1	0	0	0	0	0	1	0	8	13	110	330
7/17	22	2	31	7	6	2	1	18	6	0	0	0	1	0	0	1	1	4	3	25	3	0	3	0	3	117	351
7/18	24	6	23	18	7	4	2	1	5	1	2	-1	0	5	1	2	1	5	1	5	2	3	15	10	6	124	372
7/19	24	2	34	7	4	3	5	23	4	2	1	0	0	10	9	26	23	10	2	1	1	1	14	21	7	210	630
7/20	24	7	2	2	2	0	1	3	0	1	0	0	0	9	0	1	0	0	0	2	3	1	1	0	2	37	111
7/21	24	5	1	1	1	0	0	5	2	1	2	0	3	1	3	0	-4	0	8	1	3	1	0	2	3	39	117
7/22	24	4	8	6	8	6	1	8	1	0	1	0	2	6	8	5	0	0	1	0	2	1	5	2	2	77	231
7/23	24	5	12	9	8	5	3	1	0	0	0	1	0	2	2	0	4	1	1	2	3	0	0	0	3	62	186
7/24	24	7	6	13	7	1	0	0	0	2	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	40	120
7/25	24	2	3	2	2	0	0	3	0	0	0	1	1	1	1	1	0	0	0	1	0	1	2	0	0	21	63
7/26	24	-1	3	3	6	4	2	0	0	0	0	0	0	2	0	0	0	1	-1	0	0	4	1	0	2	26	78
7/27	24	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	-1	0	0	0	0	1	2	6	12	36
7/28	24	0	0	0	1	1	0	5	-1	6	7	0	2	2	-1	0	4	4	1	0	0	0	0	2	1	34	102
7/29	24	0	0	0	1	0	0	0	0	0	0	0	1	3	14	0	6	4	4	4	0	0	1	0	0	38	114
7/30	24	2	1	3	1	0	0	1	0	1	0	0	0	0	0	0	1	4	2	-1	2	1	0	0	0	18	54
7/31	24	3	4	5	3	0	0	0	0	0	0	1	0	0	2	0	5	0	5	2	1	1	0	0	0	32	96
8/1	24	0	0	2	2	1	3	1	1	0	0	0	0	3	0	0	-1	0	4	0	0	0	0	0	0	16	48
8/2	24	1	0	0	2	0	1	1	0	0	0	0	0	1	0	0	1	0	6	-2	0	1	0	1	0	13	39
8/3	24	1	3	1	0	0	2	0	0	0	0	1	0	1	-1	-1	0	2	0	4	0	1	0	1	0	15	45
8/4	24	1	0	1	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	2	2	4	2	0	0	16	48
8/5	24	1	0	2	0	1	1	2	2	0	0	1	0	0	0	0	1	0	1	2	-1	1	1	1	1	17	51
8/6	24	0	0	1	0	1	0	0	1	0	-1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	5	15
8/7	24	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	6	18
8/8	24	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	-1	0	3	0	1	0	0	1	6	18
8/9	24	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	2	1	1	1	1	0	1	1	6	18
8/10	24	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	1	1	0	0	0	0	0	6	18
8/11	24	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3	9
8/12	7	0	0	0	0	0	0	0						0	0	1	0	0	0	0	0	0	0	0	0	0	0

Table 8. Net upstream passage of chum salmon during hourly 20-min counts at the Kwethluk River tower, 1997. Numbers within boxes are estimates based on days when 24 h were counted.

Hours		Counted																							Total	Expanded	
Date	Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Count	Count
22-Jun	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	9	27
24-Jun	24	0	0	0	0	1	0	0	3	2	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	10	30
25-Jun	17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	12	
26-Jun	18	1	2	3	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	3	0	0	13	36	
27-Jun	18	0	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	18	
28-Jun	24	0	11	3	7	3	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	1	0	28	84	
29-Jun	18	0	2	4	1	0	0	1	0	0	0	0	0	0	0	2	8	0	0	2	3	0	4	2	1	30	87
30-Jun	18	0	9	10	2	13	3	2	0	0	0	0	0	0	0	0	0	0	1	0	1	6	0	0	47	135	
1-Jul	18	1	1	6	6	2	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	3	2	0	25	72	
2-Jul	24	0	5	7	9	3	0	0	0	0	0	0	0	0	0	-1	0	0	2	1	4	5	19	10	5	69	207
3-Jul	18	14	7	37	18	6	3	8	1	0	1	0	0	2	3	1	1	2	0	19	16	12	9	4	2	166	468
4-Jul	18	7	16	66	69	12	3	9	1	0	1	0	0	0	0	0	2	2	4	5	0	4	3	0	0	204	579
5-Jul	18	4	17	26	13	15	6	8	1	0	1	0	0	0	0	3	3	3	12	15	30	8	0	7	2	174	492
6-Jul	24	32	19	20	13	14	1	6	1	0	1	0	0	0	2	0	1	1	1	10	0	1	0	1	0	124	372
7-Jul	18	0	13	14	17	5	3	4	1	0	1	0	0	1	0	2	0	1	7	0	0	1	-1	0	5	74	204
8-Jul	18	4	7	11	5	2	1	2	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	3	41	117
9-Jul	18	0	2	3	0	2	0	0	0	2	0	-1	0	0	1	0	0	0	1	0	0	0	0	0	1	11	30
10-Jul	24	0	0	1	0	0	0	0	0	3	0	-1	0	0	0	0	1	0	3	2	1	6	0	3	2	21	63
11-Jul	18	1	3	3	2	0	4	0	0	5	0	-2	0	0	0	1	0	0	0	0	1	0	1	2	4	35	96
12-Jul	18	4	2	1	15	2	8	0	0	14	0	-5	0	0	0	0	-3	0	0	4	0	5	2	41	5	95	258
13-Jul	18	5	4	13	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	33	93
14-Jul	24	1	2	5	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3	20	60
15-Jul	24	4	5	3	5	3	8	0	0	0	0	0	0	0	0	1	1	1	5	1	4	6	7	9	12	75	225
16-Jul	24	11	13	30	22	21	10	14	6	1	-1	1	0	0	1	1	0	0	0	0	1	0	0	2	0	134	402
17-Jul	22	5	17	18	11	8	2	11	5	0	0	1	0	0	5	0	0	1	0	2	6	0	0	6	4	102	258
18-Jul	24	8	15	26	9	12	9	26	8	12	4	2	0	2	3	0	3	0	1	6	0	7	2	5	15	175	525
19-Jul	24	10	56	56	19	4	12	16	9	7	3	0	1	3	4	2	4	5	2	11	11	2	12	31	25	305	915
20-Jul	24	25	15	11	19	0	0	4	0	1	0	2	0	0	0	0	1	2	0	4	2	1	1	3	2	93	279
21-Jul	24	2	11	12	10	3	6	12	6	5	2	0	0	0	0	3	0	3	4	4	0	8	15	7	3	116	348
22-Jul	24	22	11	27	10	13	2	12	-1	6	0	0	1	3	2	0	0	0	2	2	0	3	14	2	3	134	402
23-Jul	24	14	16	14	14	21	15	1	4	0	9	3	0	0	0	0	0	0	0	2	3	7	0	11	11	145	435
24-Jul	24	7	7	25	17	7	5	0	4	1	0	0	0	2	0	2	0	5	0	1	0	4	2	1	8	98	294
25-Jul	24	4	7	13	12	19	7	6	5	0	0	2	0	0	0	0	1	3	1	1	1	1	4	4	2	95	285
26-Jul	24	1	8	9	12	9	6	22	3	2	1	0	3	5	0	1	1	1	0	7	4	3	1	3	4	106	318
27-Jul	24	9	5	10	12	2	6	5	0	3	0	0	1	2	0	1	0	0	5	3	1	1	4	16	20	106	318
28-Jul	24	6	10	9	11	14	4	17	2	7	0	1	0	2	1	1	5	1	4	6	0	6	5	6	20	138	414
29-Jul	24	1	3	3	4	5	12	7	10	0	0	0	3	2	3	0	1	2	0	0	0	0	1	0	1	58	174
30-Jul	24	0	2	2	9	8	3	3	2	1	0	0	0	2	1	1	0	2	0	0	0	0	1	1	0	38	114
31-Jul	24	4	7	7	6	5	5	4	0	1	1	2	2	0	1	2	2	0	0	2	0	1	3	-1	4	66	198
1-Aug	24	3	8	6	19	7	4	2	8	1	0	0	0	1	0	0	13	1	1	1	1	2	1	2	0	80	240
2-Aug	24	0	4	4	4	1	2	2	1	0	0	0	-1	0	0	1	2	1	5	0	0	1	5	3	0	35	105
3-Aug	24	2	4	5	2	7	3	2	0	1	1	0	0	0	2	-1	1	3	0	2	5	3	18	17	3	80	240
4-Aug	24	7	3	2	3	4	3	4	0	0	2	0	1	0	0	0	2	0	0	2	4	2	1	3	3	46	138
5-Aug	24	5	6	2	1	8	6	3	4	0	3	0	0	1	0	1	0	3	0	2	1	0	0	0	1	47	141
6-Aug	24	0	0	2	2	5	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	1	2	16	48
7-Aug	24	1	3	4	2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	13	39
8-Aug	24	0	1	1	0	1	1	1	1	0	2	0	0	0	0	0	1	1	1	0	1	0	2	0	10	24	72
9-Aug	24	0	3	0	3	0	1	0	0	0	2	1	1	1	0	0	0	1	0	0	2	0	0	4	2	21	63
10-Aug	24	2	5	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	14	42
11-Aug	24	2	4	3	1	3	2	1	1	0	1	0	0	0	2	0	2	0	1	0	0	1	0	0	0	24	72
12-Aug	7	0	1	1	0	1	1	1																		5	15

Table 9. Net upstream passage of sockeye salmon during hourly 20-min counts at the Kwethluk River tower, 1997. Numbers within boxes are estimates based on days when 24 h were counted.

Hours Counted		0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total Count	Expanded Count
Date																											
6/22	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	3	7	21
6/26	18	0	0	1	1	3	2	0	0	0	0	0	0	2	0	0	1	2	1	0	0	0	0	0	0	13	39
6/27	18	0	3	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21
6/28	24	2	11	6	11	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	34	102
6/29	18	1	5	9	10	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	31	93
6/30	18	1	9	12	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	30	90
7/1	18	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	24
7/2	24	2	3	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	14	42
7/3	18	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	9	3	8	1	0	0	23	69
7/4	18	5	9	34	21	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	228
7/5	18	2	9	14	6	2	1	3	0	0	0	0	0	0	0	0	0	2	2	1	3	3	0	0	0	48	135
7/6	24	8	3	4	4	4	0	2	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	29	87
7/7	18	0	1	3	4	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	30
7/8	18	2	7	4	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	51
7/9	18	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9
7/10	24	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
7/11	18	0	1	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
7/12	18	0	0	0	2	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	-1	3	0	15	45
7/13	18	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	18
7/14	24	2	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	27
7/15	24	1	3	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	27
7/16	24	1	0	0	3	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	24
7/17	22	1	1	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	12
7/18	24	1	0	1	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	9	27
7/19	24	0	0	0	1	0	0	3	0	0	0	0	0	0	0	5	2	0	0	0	1	1	0	2	0	15	45
7/20	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/21	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	4	12
7/22	24	1	2	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	9	27
7/23	24	3	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21
7/24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	9
7/25	24	0	1	1	0	2	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21
7/26	24	0	1	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	18
7/27	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/29	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/30	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/31	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/1	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/2	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/3	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/4	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/6	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/7	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/8	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/9	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/10	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/11	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/12	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Net upstream passage of pink salmon during hourly 20-min counts at the Kwethluk River tower, 1997. Numbers within boxes are estimates based on days when 24 h were counted.

Hours																									Total	Expanded	
Date	Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Count	Count
6/22	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/26	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/27	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/29	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/30	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/5	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9	18	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	3	9
7/10	24	0	4	5	6	3	0	2	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	25	75
7/11	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12	18	2	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	8	18	
7/13	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/14	24	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	6	18	
7/15	24	0	5	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	8	24	
7/16	24	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	7	21
7/17	22	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	6	
7/18	24	0	0	3	4	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	14	42	
7/19	24	0	0	0	6	0	0	5	0	0	0	0	0	0	0	0	0	0	0	2	0	5	0	5	7	30	90
7/20	24	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	21
7/21	24	0	3	0	2	1	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	11	33
7/22	24	2	1	1	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	9	27
7/23	24	1	2	1	1	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	18	54
7/24	24	1	5	3	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	13	39
7/25	24	0	0	2	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21
7/26	24	0	1	2	6	1	3	11	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	27	81
7/27	24	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	1	0	0	1	1	3	10	30
7/28	24	1	0	0	1	0	1	2	0	2	0	0	0	0	0	0	0	0	1	2	0	1	0	1	2	14	42
7/29	24	1	0	0	1	0	0	3	0	0	0	0	0	1	0	3	0	2	2	0	0	0	0	0	1	14	42
7/30	24	0	1	3	1	1	0	3	1	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	14	42
7/31	24	0	2	0	1	2	1	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	10	30
8/1	24	0	3	3	3	3	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	0	16	48
8/2	24	0	0	0	3	2	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	8	24
8/3	24	0	1	2	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	8	24
8/4	24	1	1	1	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	11	33
8/5	24	0	2	2	0	0	1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	24
8/6	24	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	7	21
8/7	24	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
8/8	24	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	15
8/9	24	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12
8/10	24	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	8	24
8/11	24	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9
8/12	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3

Table 11. Net upstream passage of coho salmon during hourly 20-min counts at the Kwethluk River tower, 1997. Numbers within boxes are estimates based on days when 24 h were counted.

Date	Hours Counted	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total Count	Expanded Count
6/22	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/25	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/26	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/27	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/29	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/30	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/5	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/9	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/11	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/14	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/15	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/16	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/19	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/20	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/21	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/22	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/23	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/25	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/26	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/27	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/29	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/30	24	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	2	0	0	0	0	0	0	6	18
7/31	24	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	6	18
8/1	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	6
8/2	24	2	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	7	21
8/3	24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2	1	0	0	2	3	0	13	39
8/4	24	1	1	0	0	1	0	2	0	1	0	0	0	0	0	1	1	1	3	6	5	8	9	6	5	51	153
8/5	24	8	4	6	4	3	4	1	0	2	0	0	0	1	1	3	2	0	15	1	1	15	0	1	2	74	222
8/6	24	1	4	0	4	7	1	0	1	0	0	0	0	0	2	1	0	1	8	0	0	0	2	1	7	40	120
8/7	24	4	2	2	1	1	2	1	0	0	0	0	1	0	0	2	0	0	3	0	3	0	3	2	3	30	90
8/8	24	0	0	3	0	0	0	0	2	2	1	1	0	0	1	0	1	0	0	1	4	1	2	0	5	24	72
8/9	24	0	-1	1	0	0	0	0	0	2	0	0	1	0	0	0	0	0	1	1	1	0	4	9	4	23	69
8/10	24	0	3	2	2	1	1	3	0	1	0	1	0	2	0	0	0	0	1	0	0	4	2	5	6	34	102
8/11	24	3	2	1	0	2	0	4	2	1	2	0	0	3	4	9	6	1	1	1	1	2	0	0	0	45	135
8/12	7	4	3	3	2	0	0	3																		15	45

Table 12. Daily salmon passage estimates at the Kwethluk River tower 1997. Counts less than 24 h are extrapolated to full day counts.

Date	Hours Count	Chinook			Sockeye			Chum			Pink		Coho	
		Daily Total	Cum. Total	Cum. %	Daily Total	Cum. Total	Cum. %	Daily Total	Cum. Total	Cum. %	Daily Total	Cum. Total	Daily Total	Cum. Total
6/22	18	0	0	0	0	0	0	0	0	0	0	0	0	0
6/23	18	51	51	0	0	0	0	27	27	0	0	0	0	0
6/24	24	288	339	3	0	0	0	30	57	1	0	0	0	0
6/25	17	138	477	5	21	21	2	12	69	1	0	0	0	0
6/26	18	153	630	6	39	60	4	36	105	1	0	0	0	0
6/27	18	216	846	8	21	81	6	18	123	1	0	0	0	0
6/28	24	324	1,170	11	102	183	13	84	207	2	0	0	0	0
6/29	18	315	1,485	14	93	276	20	87	294	3	0	0	0	0
6/30	18	261	1,746	17	90	366	27	135	429	4	0	0	0	0
7/1	18	63	1,809	17	24	390	28	72	501	5	0	0	0	0
7/2	24	444	2,253	22	42	432	31	207	708	7	0	0	0	0
7/3	18	777	3,030	29	69	501	36	468	1,176	11	0	0	0	0
7/4	18	825	3,855	37	228	729	53	579	1,755	16	0	0	0	0
7/5	24	1,200	5,055	49	135	864	63	492	2,247	21	0	0	0	0
7/6	24	1,050	6,105	59	87	951	69	372	2,619	25	0	0	0	0
7/7	18	147	6,252	60	30	981	71	204	2,823	26	0	0	0	0
7/8	18	93	6,345	61	51	1,032	75	117	2,940	28	0	0	0	0
7/9	18	15	6,360	61	9	1,041	76	30	2,970	28	9	9	0	0
7/10	24	3	6,363	61	6	1,047	76	63	3,033	28	75	84	0	0
7/11	18	69	6,432	62	0	1,047	76	96	3,129	29	0	84	0	0
7/12	18	93	6,525	63	45	1,092	79	258	3,387	32	18	102	0	0
7/13	18	186	6,711	65	18	1,110	81	93	3,480	33	0	102	0	0
7/14	24	192	6,903	66	27	1,137	83	60	3,540	33	18	120	0	0
7/15	24	174	7,077	68	27	1,164	85	225	3,765	35	24	144	0	0
7/16	24	330	7,407	71	24	1,188	86	402	4,167	39	21	165	0	0
7/17	24	351	7,758	75	12	1,200	87	258	4,425	42	6	171	0	0
7/18	24	372	8,130	78	27	1,227	89	525	4,950	46	42	213	0	0
7/19	24	630	8,760	84	45	1,272	93	915	5,865	55	90	303	0	0
7/20	24	111	8,871	85	0	1,272	93	279	6,144	58	21	324	0	0
7/21	24	117	8,988	86	12	1,284	93	348	6,492	61	33	357	0	0
7/22	24	231	9,219	89	27	1,311	95	402	6,894	65	27	384	0	0
7/23	24	186	9,405	90	21	1,332	97	435	7,329	69	54	438	0	0
7/24	24	120	9,525	92	3	1,335	97	294	7,623	72	39	477	0	0
7/25	24	63	9,588	92	21	1,356	99	285	7,908	74	21	498	0	0
7/26	24	78	9,666	93	18	1,374	100	318	8,226	77	81	579	0	0
7/27	24	36	9,702	93	0	1,374	100	318	8,544	80	30	609	0	0
7/28	24	102	9,804	94	0	1,374	100	414	8,958	84	42	651	0	0
7/29	24	114	9,918	95	0	1,374	100	174	9,132	86	42	693	0	0
7/30	24	54	9,972	96	0	1,374	100	114	9,246	87	42	735	18	18
7/31	24	96	10,068	97	0	1,374	100	198	9,444	89	30	765	18	36
8/1	24	48	10,116	97	0	1,374	100	240	9,684	91	48	813	6	42
8/2	24	39	10,155	98	0	1,374	100	105	9,789	92	24	837	21	63
8/3	24	45	10,200	98	0	1,374	100	240	10,029	94	24	861	39	102
8/4	24	48	10,248	99	0	1,374	100	138	10,167	95	33	894	153	255
8/5	24	51	10,299	99	0	1,374	100	141	10,308	97	24	918	222	477
8/6	24	15	10,314	99	0	1,374	100	48	10,356	97	21	939	120	597
8/7	24	18	10,332	99	0	1,374	100	39	10,395	98	6	945	90	667
8/8	24	18	10,350	100	0	1,374	100	72	10,467	98	15	960	72	759
8/9	24	18	10,368	100	0	1,374	100	63	10,530	99	12	972	89	828
8/10	24	18	10,386	100	0	1,374	100	42	10,572	99	24	996	102	930
8/11	24	9	10,395	100	0	1,374	100	72	10,644	100	9	1,005	135	1,065
8/12	6	0	10,395	100	0	1,374	100	15	10,659	100	3	1,008	45	1,110

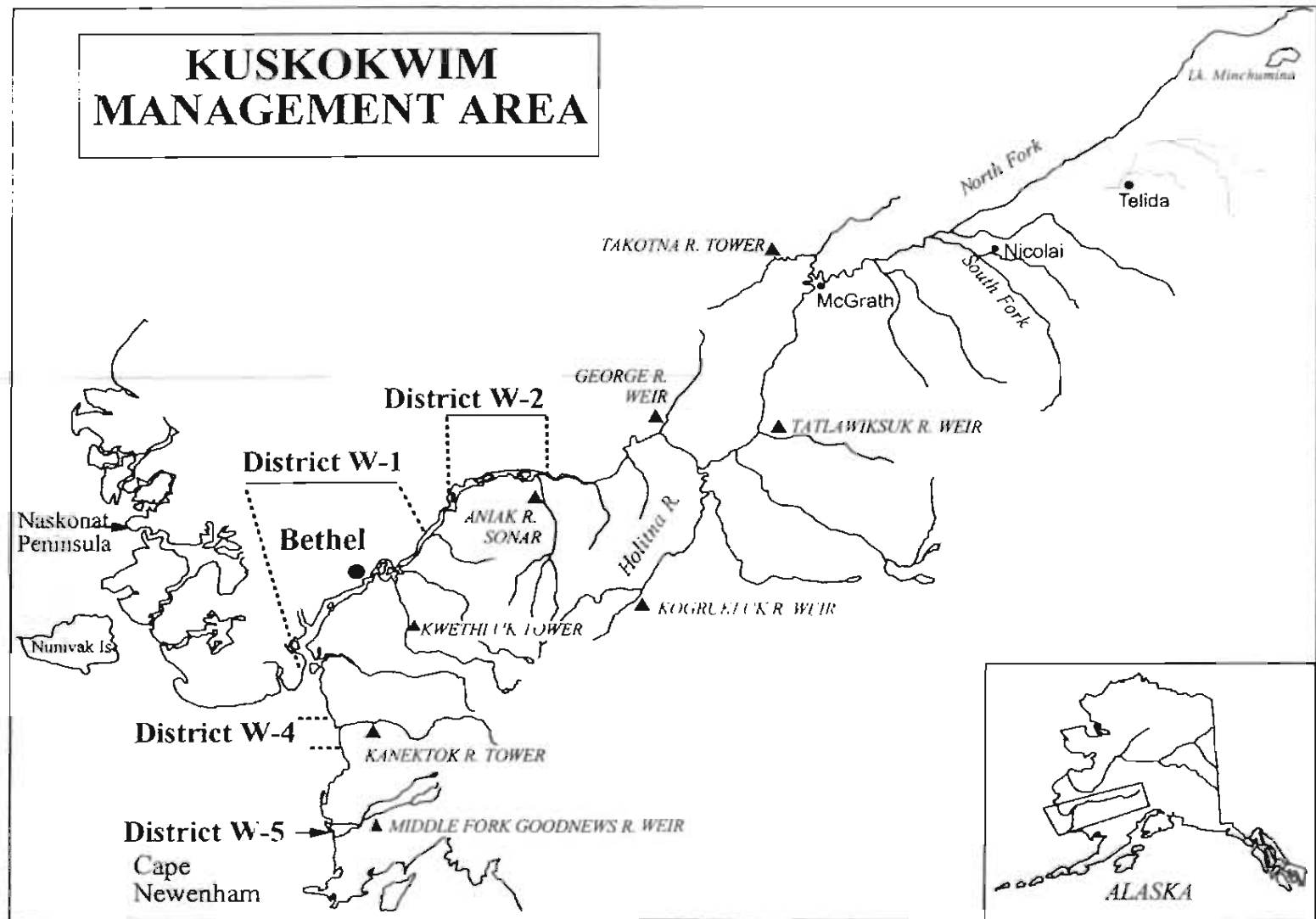


Figure 1. Map of the Kuskokwim Area showing location of commercial fishing districts and salmon escapement assessment projects, including the Kwethluk River tower.

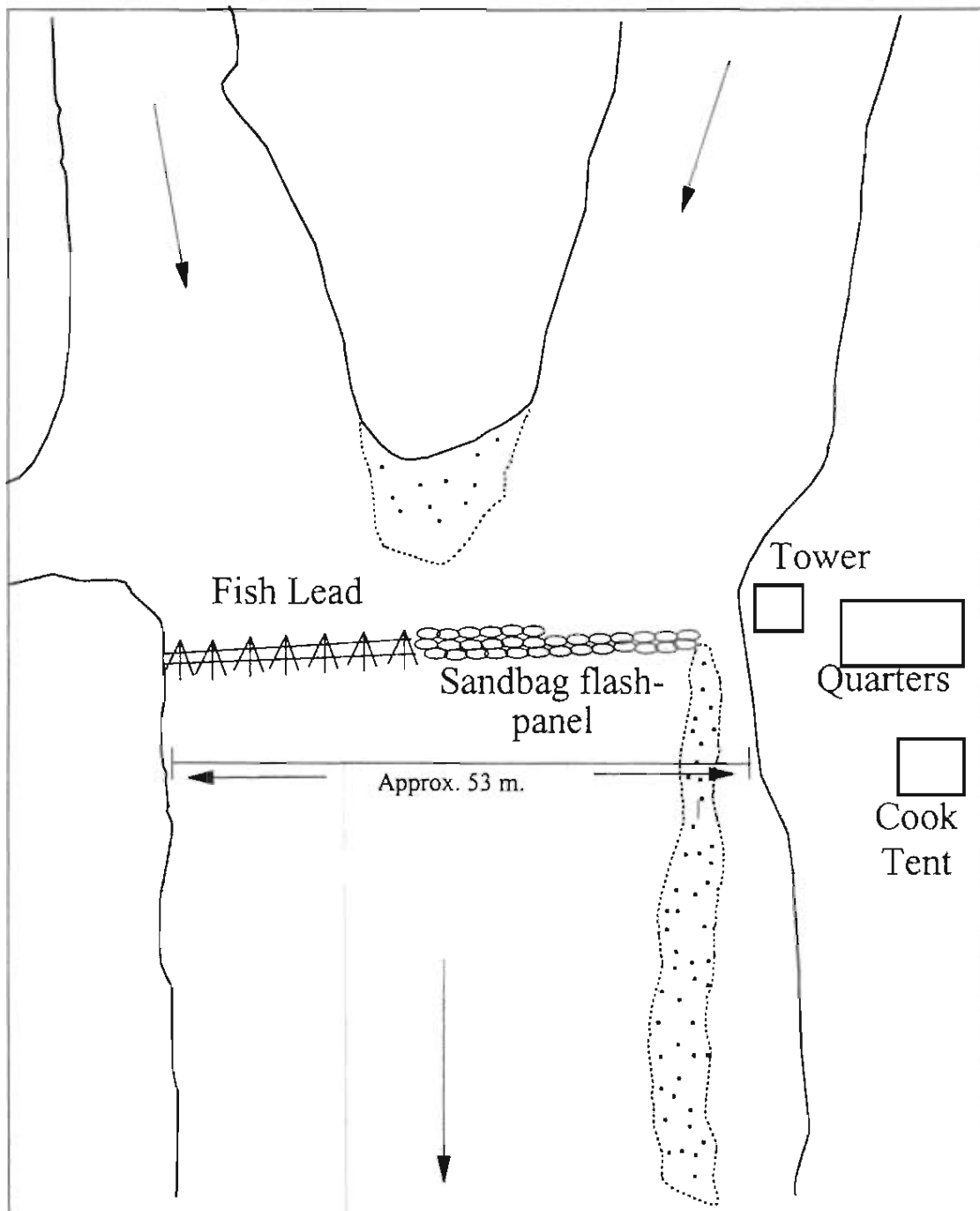


Figure 2. Schematic of the Kwethluk River tower and field camp.

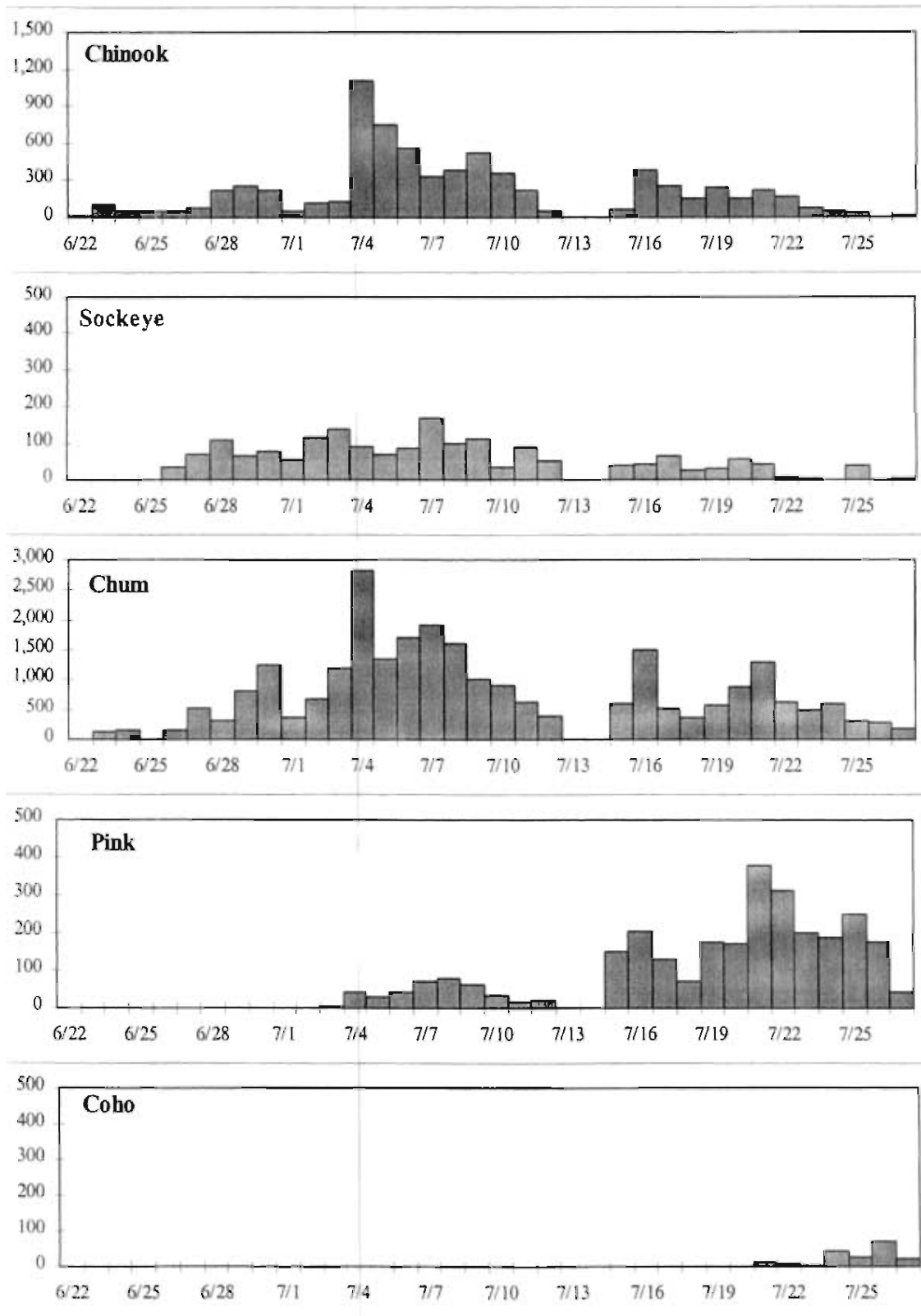


Figure 3. Daily passage estimates of salmon at the Kwethluk River tower, 1996.

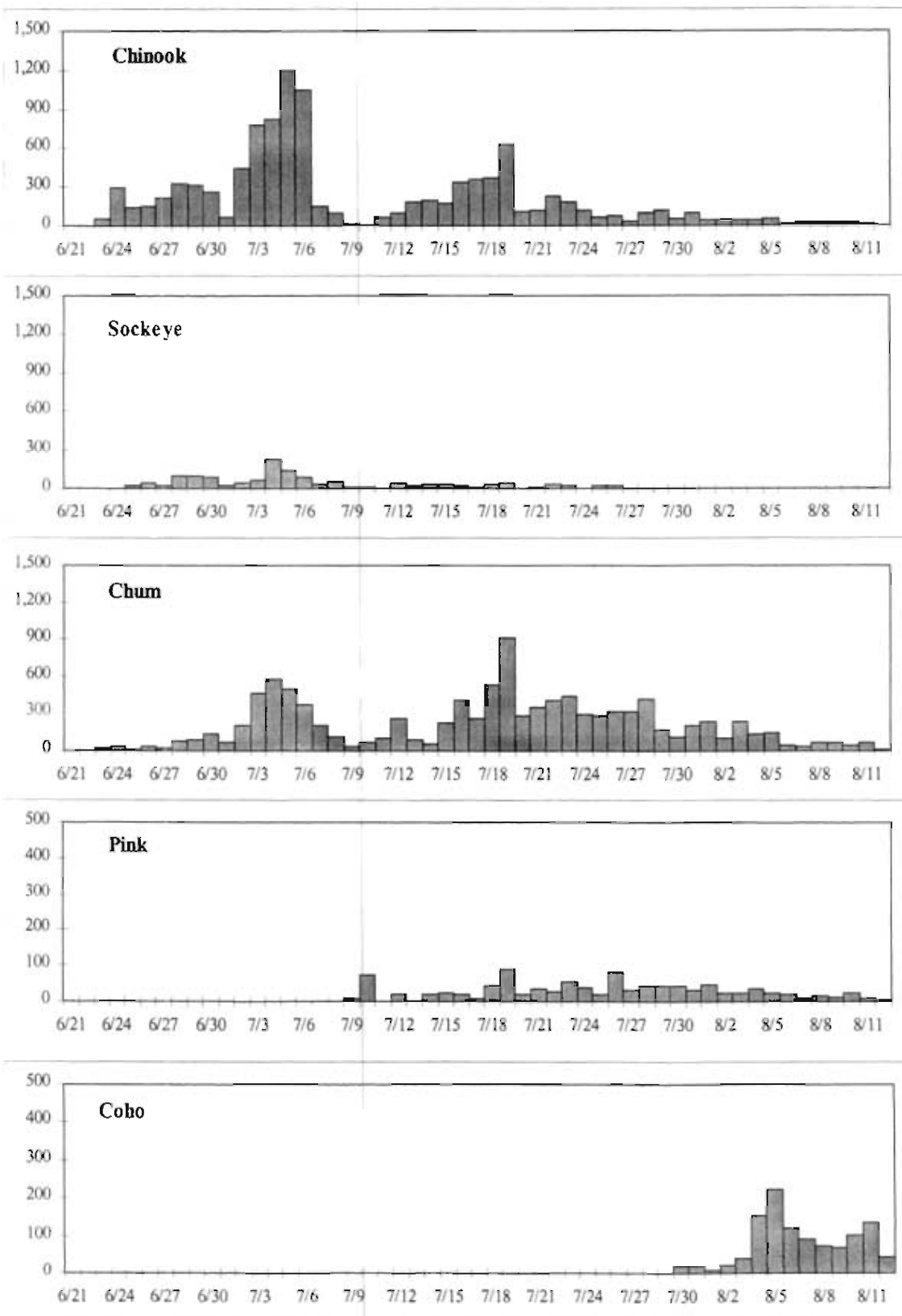


Figure 4. Daily passage estimates of salmon at the Kwethluk River tower, 1997.

Appendix A.I. Daily meteorological and hydrological conditions at the Kwethluk River tower, 1996.

Date	Time	Precip.	Wind		Cloud Cover	Temperature (C)		Water Level (cm)		Water Clarity
			Direct	Speed (mph)		Air	Water	Up	Down	
20-Jun										
21-Jun	1200	1			4					clear
22-Jun	1200	0		calm	3					clear
23-Jun	1200	0	SW	10-15	4					clear
24-Jun	1200	0	W	10	4			steady		clear
25-Jun	0700	2	SW	3-5	4			0.5		clear
26-Jun										
27-Jun										
28-Jun										
29-Jun	1200	0								
30-Jun	1200	0	W	3	4			2		silty
1-Jul	1200	0		calm	4			steady		clear
2-Jul	1200	0		calm	4			5		clear
3-Jul	1200	0		calm	4			steady		clear
4-Jul	0600	0		calm	1				1	clear
5-Jul	0700	0		calm	1			steady		clear
6-Jul	0700	0	W	<5	4				3	clear
7-Jul										
8-Jul										
9-Jul	0700	0	SW	5-7	2	17	12		1	clear
10-Jul	0700	0	NE	1-3	4	10	10		1	clear
11-Jul	0700	0	SW	1-3	4	9	9		5	clear
12-Jul	0700	2	S	5-7	4	10	10	5		clear
13-Jul	0700	2		calm	3	8	8	0.5		grey
14-Jul	0900	2	W	5-7	3	9	9		1	cloudy
15-Jul	0700	0		calm	1	6	6	steady		cloudy
16-Jul	0700	2		calm	4	11	12		3	clear
17-Jul	0700	2	SW	5-7	4	10	10	0.5		clear
18-Jul	0700	2	SW	1-3	4	10	9	0.5		clear
19-Jul	0700	2		calm	4	11	9	0.5		clear
20-Jul	0700	0		calm	4	8	10	1		clear
21-Jul	0900	0		calm	3	15	10	steady		clear
22-Jul	0700	0		calm	1	8	12		1	clear
23-Jul	0700	0		calm	1	7	12	1		clear
24-Jul	0700	1	calm		4	11	12		1	clear
25-Jul	0700	2	SW	3-5	4	12	12		1.5	clear
26-Jul	0730	2	SW	40-50	4	11	10		0.5	clear
27-Jul	1700	2		calm	4	12	10	1.5		cloudy
28-Jul	0900	2	SW	10-15	4	13	10	2.5		cloudy
29-Jul	0700	2		calm	4	9	10	5		cloudy
30-Jul	0700	2	SW	5-7	4	11	10	0.5		v. cloudy
31-Jul	0700	0		calm	4	8	10	2.5		muddy
1-Aug	0700	2	SW	8-10	4	9	9	4		muddy
2-Aug	0700	1	SW	10-12	4	8	9	5		muddy
3-Aug	0900	1	S	1-3	4	9	10	2		muddy
4-Aug	0900	2	S	5-7	4	8	9		0.5	muddy
5-Aug	0900	1	S	1-3	4	9	9		2.5	muddy
6-Aug	0700	0		calm	4	5	7.5	4		muddy
7-Aug	0700	0		calm	4	7	9	0.5		muddy
8-Aug	0700	1	SW	20-25	4	8	10		1	muddy
9-Aug	0700	1	S	3-5	4	9	10		1.5	muddy

Codes:

Precipitation:

0 - none

1 - light or intermittent rain

2 - continuous rain

3 - thundershowers

Cloud Cover:

1 - clear sky

2 - less than 50% cover

3 - more than 50% cover

4 - solid overcast (high or low)

5 - fog and/or smoke

Appendix A.2. Daily meteorological and hydrological conditions at the Kwethluk River tower, 1997.

Date	Time	Precip.	Wind		Cloud Cover	Temperature (C)		Water Level (cm)		Water Clarity
			Direct	Speed (mph)		Air	Water	Up	Down	
16-Jun	0700	1			4		9			clear
17-Jun	1700	1	NE	20	4	12	9			clear
18-Jun	0830	0	NE	10	4	15	10			clear
19-Jun	0800	0		calm	1	16	11			clear
20-Jun	1700	0	SW	5-10	2	15	10	3		clear
21-Jun	1000	0		calm	3	13	11		steady	clear
22-Jun	1700	0	NW	5-10	2	15	12		steady	clear
23-Jun	0700	0		calm	2	12	10		steady	clear
24-Jun	0700	0		calm	4	15	13		1	clear
25-Jun	0700	0		calm	3	15	12	4		clear
26-Jun	0700	0		calm	4	15	10	0.5		clear
27-Jun	0700	0		calm	5	9	12	1.5		clear
28-Jun	0700	0		calm	1	9	12		2.5	clear
29-Jun	0700	0		calm	4	12	13		0.5	clear
30-Jun	0700	1		calm	4	11	13		steady	clear
1-Jul	0700	0		calm	4	13	13		steady	clear
2-Jul	0700	1		calm	4	11	13		1	clear
3-Jul	0700	0		calm	4	13	13		1	clear
4-Jul	0700	0		calm	1	13	14		2	clear
5-Jul	0700	0		calm	1	11	15		steady	clear
6-Jul	0700	0	NW	5-7	1	13	15		1	clear
7-Jul	0700	0		calm	5	11	13		1	clear
8-Jul	0700	2	S	10-15	4/5	10	13	1		clear
9-Jul	0700	1	S	3-5	4/5	10	13	1		clear
10-Jul	0700	0		calm	4	10	13		steady	clear
11-Jul	0700	0		calm	1	11	13		2	clear
12-Jul	0700	0		calm	1	11	13		2	clear
13-Jul	0700	0		calm	1	10	13		2	clear
14-Jul	0700	0		calm	3	8	11		2	clear
15-Jul	0700	0		calm	1		11		2	clear
16-Jul	0700	0	E	3-5	2	10	13		1	clear
17-Jul	0700	0		calm	4	13	11		1	clear
18-Jul	0700	0		calm	4	10	12		steady	clear
19-Jul	0700	0		calm	4	10	12	2		clear
20-Jul	0700	0		calm	4	13	12	1		clear
21-Jul	0700	0		calm	1	11	13	1		clear
22-Jul	0700	0		calm	1	8	13	1		clear
23-Jul	0700	0	S	1-3	4	13	14		steady	clear
24-Jul	0700	1	S	1-3	4	11	12	1.5		clear
25-Jul	0700	1	S	3-5	4	10	12		steady	clear
26-Jul	0700	1	S	1-3	4	12	12		2	clear
27-Jul	0700	0		calm	4	11	12		2	clear
28-Jul	0700	0		calm	3	9	13		1	clear
29-Jul	0700	1		calm	4	13	14	1		clear
30-Jul	0700	1		calm	4	15	14		steady	clear
31-Jul	0700			calm	4	13	13		steady	clear
1-Aug	0700			calm	3	8	13		steady	clear
2-Aug	0700		SE	3-5	1	9	13	1.25		clear
3-Aug	0700		S	5-10	4	15	15		1.75	clear
4-Aug	0700			calm	4/5	14	14	1.5		clear
5-Aug	0700			calm	4	15	16			clear
6-Aug	0700			calm	3	11	14		2	clear
7-Aug	0700			calm	1	10	14		2	clear
8-Aug	0700		N	3-5	2/5	13	14	1.5		clear
9-Aug	0700		NE	1-3	3	13	13		steady	clear
10-Aug	0700		SE	5-7	3	13	13		2	clear
11-Aug	0700		NE	5-7	4	10	12	3.5		murky
12-Aug	0700		S	10-15	4	11	11	7		muddy

Codes:

Precipitation:

0 - none
 1 - light or intermittent rain
 2 - continuous rain
 3 - thundershowers

Cloud Cover:

1 - clear sky
 2 - less than 50% cover
 3 - more than 50% cover
 4 - solid overcast (high or low)
 5 - fog and/or smoke